Dust in β Pic / Vega Main Sequence Systems

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The β Pictoris disk is an especially dense and fortuitously edge-on arrangement of solid material around a nearby A5 main sequence star, a prime example of a new class of objects discovered by IRAS. Three similar systems (α Lyrae = Vega, A0; α Piscis Austrinus = Fomalhaut, A3; and ϵ Eridani, K2) have been resolved in the IR or sub-mm.

The grain temperatures in the prototype systems are 50-150 K, implying disk scales of a few $\times$ 100 AU. Each has a central zone of relatively low density with size similar to our solar system's planetary zone. Lifetime arguments imply that the dust is not primordial but must be replenished from larger bodies. The dust in the resolved systems appears to lie in disks in the stellar equatorial planes based on a comparison between the shapes of the emitting regions and values of stellar rotational v sin(i).

As many as 100 other nearby main sequence stars have far-IR excesses in IRAS and ISO data. Circumstellar dust appears to be common among main sequence stars and may persist well beyond the protoplanetary stage. At the same time, some nearby systems with especially dense disks may be very young stars with disks still clearing.

Spectra of the material close to β Pic and 51 Oph show 10 μm silicate emission mineralogically resembling the grains in comet comae. Silicate and organic hydrocarbon emission has been observed from other systems.

The best solar system analog in scale and morphology to the main sequence disks is the Kuiper Belt. Ground-based and HST observations have revealed a population of planetesimals in the Kuiper Belt, allowing the equilibrium dust population and evolutionary status of the extrasolar systems to be compared with the KB. The IR emission from the zodiacal and KB dust components of our solar system would be much easier to detect externally than radiation from the planets themselves.

Abstract submitted for 1996 DPS meeting

Date submitted: LPI electronic form version 5/96

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Special instructions: Tue Aug 27 15:10:50 CDT 1996

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